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(54) Slant correction for a video camera apparatus.

(57) The slant amount of the entire video camera apparatus to the vertical direction is detected by the slant detector by detecting the horizontal and vertical signal quantity detection or by the mechanical vertical direction detecting means, and the memory control means reads out the video signal while controlling the address of the memory means so as to correct the slant of the video signal stored in the memory device depending on the slant amount, and since the memory device is composed of two systems of memory means, so that the slant may be always corrected in real time in moving picture, thereby presenting a stable video output.

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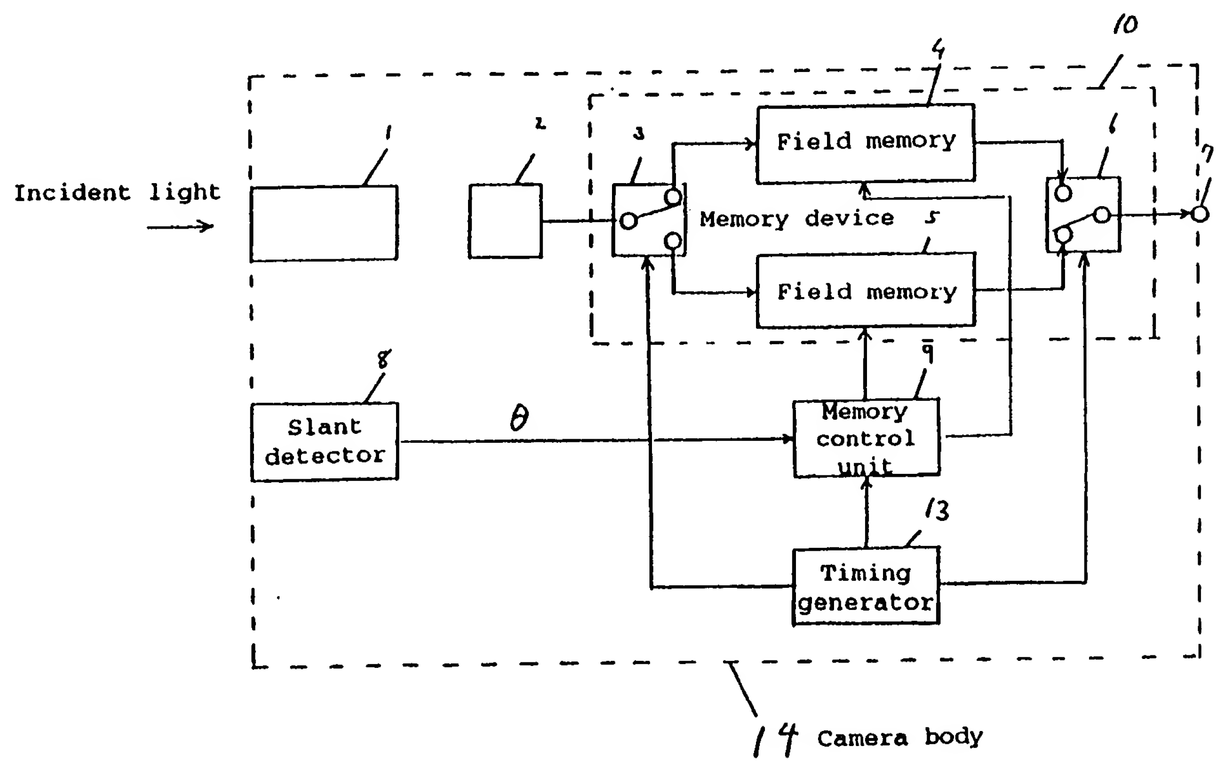
Fig. 1


Incident light
1
2
3
Field memory
4
Memory device
5
Field memory
6
7
10
8
Slant detector
θ
9
Memory control unit
13
Timing generator
14
Camera body

The present invention relates to a video camera apparatus for converting an image of an object into a video signal.

In a video camera apparatus, recently, camera fluctuation preventive devices for storing the image information in a memory means, and delivering the information corrected of the camera fluctuation on the basis of the information from the camera fluctuation detecting means are developed. It is, however, impossible to correct the image slant by such camera fluctuation preventive devices, the reproduced images are inclined and cannot be appreciated if the user takes pictures while walking. Fig. 9 shows a block diagram of a video camera apparatus in the prior art. In Fig. 9, the incident light entering a camera lens 50 is photo-electrically converted by a photoelectric converter 51, and is delivered to an output end 52. In this case, if the conventional video camera apparatus is inclined toward the subject, the subject indicated by arrow which should be vertical as shown in Fig. 10 (A) is delivered in a slant state. Here, (1) indicates the signal reading direction. Therefore, by recording and reproducing the signal in Fig. 10 (A), the reproduced image is a slant image.

As a method of correcting the image slant, an example is disclosed in the Japanese Laid-open Patent Sho. 58-222382. In this method, by the slant signal from the slant detecting means, by controlling the address so as to correct the slant of the image signal stored in the memory means and reading out, the slant of the output signal is corrected. The method, however, disclosed in JP 58-222382 is limited to the still picture, and a general moving picture as in the video camera apparatus could not be corrected for slant.

It is hence a primary object of the invention to present a video camera apparatus capable of correcting the image slant due to inclination of the video camera apparatus.

The video camera apparatus of the invention is intended to detect a slant extent with respect to the vertical direction of the entire video camera apparatus by a slant detecting means, read out the video signal while controlling an address of a memory device by a memory control means so as to correct the slant depending on the slant extent of the video signal stored in the memory device, in which the memory device is composed of two memory means so as to alternately repeat a write mode and a read mode in a specific period to set one in the read mode and the other in the write mode, thereby always correcting the slant in real time with respect to the moving picture to obtain a stable video output.

Fig. 1 is a block diagram showing an example of video camera apparatus of the invention;

Fig. 2 is a block diagram showing other example of video camera apparatus of the invention;

Fig. 3 is a diagrfam showing video signal range handled by the video camera apparatus of the invention;

Fig. 4 is a block diagram showing an example of memory control device of video camera apparatus of the invention;

Fig. 5 is a vector diagram for explaining the mechanical slant amount detecting method in the vertical direction of the video camera apparatus of the invention;

Fig. 6 is a block diagram for explaining the vertical direction detecting method in a signal processing circuit in video camera apparatus of the invention;

Fig. 7 is a slant information distribution diagram on two-dimensional frequency axis for the slant amount detecting method by the signal processing circuit;

Fig. 8 is a block diagram showing the shared use of the video camera apparatus and camera shake preventive device of the invention;

Fig. 9 is a block diagram showing a conventional video camera apparatus;

Fig. 10 is a schematic diagram showing the slant correction action;

Fig. 11 is a signal waveform diagram for explaining the slant amount detecting method by the signal processing circuit; and

Fig. 12 is a block diagram showing an example of constitution of horizontal signal detecting part and vertical signal detecting part in the slant amount detecting method of the signal processing circuit.

Fig. 1 is a block diagram showing an embodiment of a video camera apparatus of the invention. The light entering through a camera lens 1 is fed into a photoelectric converter 2 to be photoelectrically converted into a video signal, and is stored in a memory device 10. The video signal enterng the memory device 10 is fed into a first switch 3. The fist switch 3 is tilted to the first field memory 4 side in the first field period, and is tilted to the second field memory 5 side in the next second field period. The video signal in the first field is stored in the first field memory 4, and the video signal in the second field is stored in the second field memory 5. The video signal stored in the first field memory 4 is read out in the next second field period, and the video signal stored in the second field memory 5 is read out in the next first field period. A second switch 6 operates in the reverse phase of the first switch 3, and is alternately tilted to the first field memory 4 and the second field memory 5, thereby delivering a series of video siganls to the output end 7. Besides, the image slant information detected by a slant detector 8 is fed into a memory control unit 9, and the memory control unit 9 controls the read action of the first field memory 4 and second field memory 5 of the memory device 10 depending on the slant information, and delivers signals so as to correct the slant of the output moving picture signals in real time.

Fig. 3 shows a video signal range stored in the

memory device 10 by the output signal from the photoelectric converter 2. In Fig. 3, all siganls corresponding to the video margin circle 61 are stored in the memory device 10. The video margin circle 61 is a circle circumscribing both a first video range 62 when the video camera is not inclined and a second image range 63 when the video camera is inclined, or having a larger diameter.

Fig. 4 shows the constitution of the memory control unit 9. The memory control unit comprises a reference address generating part 15 and coordinate axis converting part 16. The slant information θ (the slant angle to the vertical direction) of the video camera apparatus delivered from the slant detector 8 is fed into the coordinates axis converting part 16. From the reference address generating part 16, the address to be given to the memory device 10 when the slant information θ is 0 is fed into the coordinate axis converting part 16. Suppose the address (X0, Y0) is given from the reference address generating part. At this time, in the coordinate axis converting part 16, for example, the coordinate conversion is calculated as

$$X1 = X0 \times COS\theta + Y0 \times SIN\theta$$
$$Y1 = XO \times SIN\theta + Y0 \times COS\theta$$

and a new address (X1, Y1) is obtained. According to this new address, when the signal is read out from the memory device 10, a corrected video signal is obtained. The coordinate conversion calculation in the coordinate axis conversionn part 16 may be realized, for example, by the program of a microcomputer. The action timings of the first switch 3, second switch 6 and medmory control unit 9 are determined by the field signal generated by the timing generating part 13.

Fig. 10 shows a concept of slant correction action. When the camera device itself is inclined, in the conventional method, the camera device output signal is also inclined as shown in Fig. 10 (A).
Accordingly, the image in Fig. 10 (A) is once stored in te memory device 10, and according to the slant information delivered from the slant detector 8, it is controlled and read out by the memory control unit 9. In other words, as shown in Fig. 10(B), supposing (2) to be the reading direction corrected of slant, by reading out the video signal in the direction of (2) from the memory deivce 10, a normal signal without slant is obtained as the output signal from the camera device as shown in Fig. 10 (C). As the slant detecting means 8, for example, a vertical direction detector 11 is used. As the vertical direction detector 11, gyro mechanism or mechanical vertical direction detecting means is used. For example, as shown in Fig. 5, when te video camera main body 14 is seen from the front, if the inclination of the camera boby at an angle of θ to the vertical direction, that is, in the direction of the gravity of the earth is detected by the vertical direction detector 11, the reading of the video signal from the memory device 10 is controlled so as to correct the slant θ The vertical direction detectotr 11 is used in a state of being fixed to the camera body.

Fig. 7 is a two-dimensional frequency characteristic diagram showing the existing region of the horizontal line signal and vertical line signal. The vertical line signal existing region (the vertically shaded area in screen) is the region of Fig. 7 (A), and the horizontal line existing region (the horizontally shaded area in screeen) is the region of (B). When the camera body is not inclined, by nature, the horizontal line components and vertical line components are maximum, which may be utilized as the evaluation value of the slant amount.

Fig. 2 is a block diagram showing other embodiment of the video camera apparatus of the invention. That is, as the input information to the slant detecting means 8, the output signal of the photoelectric converting means 2 is used. The slatn detector 8 of the video camera in Fig. 2 is composed, for example, as shown in Fig. 6. As shown in Fig. 6, there are disposed a horizontal signal detector 40, vertical signal detector 41, first wave detector 42, second wave detector 43, and control signal generator 44. Fig. 11 shows signal waveforms of parts of the slant detector 8 shown in Fig. 6. For example, an input signal is assumed to be a signal lowered in the video signal level in a window shape in the middle as shown in Fig. 11 (A). As shown in (B), the signal level change in horizontal line a is as in (B-1). The signal level change in vertical line b is as in (B-2). The horizontal signal detector 40 selects the vertical line signal comonents of the input signal, and delivers the signal as in (C-1). Furthermore, the horizontal signal quantity is detected by the first wave detectort 42, and the vertical detection output is delivered to the control signal generator 44 as in (D-1). The vertical signal detector 41 selects the vertical signal components of the input signal, and delivers the signal as in (C-2). Furthermore, the vertical signal quantity is detected by the second wave detector 43, and the signal as in (D-2) is delivered to the control signal generator 44. In the control signal generator 44, the slant information is delivered so that either the horizontal signal or the vertical signal,or both the horizontal signal and the vertical signal may be maximum. For example, the output signals of the first wave detector 42 and the second wave detector 43 are summed up. The output signal quantity of the control signal generator 44 is as in (E). In (E), the axis of abscissas denotes the camera body slant angle, and the axis of ordinates indicates the control signal quantity. Since the control signal quantity becomes the maximum at the camera body slant of 0, the address of the memory device 10 is controlled so as to maximize the control signal quantity.

Fig. 12 (A) is a block diagram showing an embodiment of horizontal signal detector 40, and (B) shows the vertical signal detector 41. In (A), the signal fed into the horizontal signal detector 40 is passed

through the horizontal high pass filter 18 through the vertical low pass filter 17, so that the vertical line components of the video signal are extracted. In (B), the signal entering the horizontal signal detector 40 is passed through the vertical high pass filter 20 through the horizontal low pass filter 19, so that the horizontal line components of the video signal may be extracted. According to this method, the slant amount can be detected by the signal processing alone, and the external sensor is not necessary.

Fig. 8 shows a block diagram when combined with the camera fluctuation detecting means 12. As shown in Fig. 8. by sharing the memory device control means 9 and the subsequent devices, camera fluctuation prevention and slant correction may be realized in a compact constitution. The art in Fig. 8 may be easily realized by employing the conventional camera shake preventive technololgy, for example, as disclosed in the Japanese Laid-open Patent Hei. 1-125064.

Besides, in either Fig. 1 or Fig. 2, AD converting means may be used after the photoelectric converter 2, and the subsequent system may be realized by digital signal processing .

Claims

1. A video camera apparatus comprising a slant detector, a memory device having at least two memories, and a memory control unit, in which a reading address to be applied to the memory device is calculated in the memory control unit according to slant information with respect to the vertical direction of the video camera apparatus detected by a slant detector, and a video signal corrected of slant in real time is delivered.

2. A video camera apparatus according to claim 1, wherein the slant detector comprises a gyro mechanism or mechanical vertical direction detector.

3. A video camera apparatus according to claim 1, wherein the slant detector is a slant detector for delivering the slant information so that either a horizontal signal or a vertical signal, or both the horizontal signal and the vertical signal may be maximum.

4. A slant detector comprising a horizontal signal detector, a vertical signal detector, a first wave detector, a second wave detector, and a control signal generator, wherein the input signal is fed into the horizontal signal detector and the vertical signal detector, the horizontal signal component detected by the horizontal signal detector is detected of the horizontal signal quantity by the first wave detector and fed into the control signal generator, and the vertical signal component detected by the vertical signal detector is detected of the vertical signal quantity by the second wave detector and fed into the control signal generator, thereby delivering the slant information.

5. A video camera apparatus comprising:
   an imaging means for converting an image of an object formed by light from an object to a video signal;
   a memory means having two memories each changing its operating mode at predetermined intervals between a write mode in which the video signal is written into the memory and a read mode in which the video signal written in the memory is read out, each of the two memories being in one of the write mode and the read mode when the other of the two memories is in the other of the write mode and the read mode;
   a detecting means for detecting a positional slant of the image and producing a detection signal indicative of the positional slant; and
   a memory control means responsive to said detection signal for controlling a read operation of each of the two memories in the read mode so as to compensate for the positional slant of the image.

6. A video camera apparatus according to claim 5, wherein said detecting means comprises a means for detecting a positional slant of a body of said apparatus relative to a direct ion of gravity.

7. A video camera apparatus according to claim 5, wherein said detecting means comprises a means for detecting a quantity of a horizontal signal component of the video signal, a means for detecting a quantity of a vertical signal component of the video signal, and means for detecting a positional slant of the image from the quantities of the horizontal and vertical signal components.

8. A video camera apparatus according to claim 5, wherein each of said two memories comprises a field memory which changes the write mode and the read mode at vertical scanning intervals.

Fig. 1

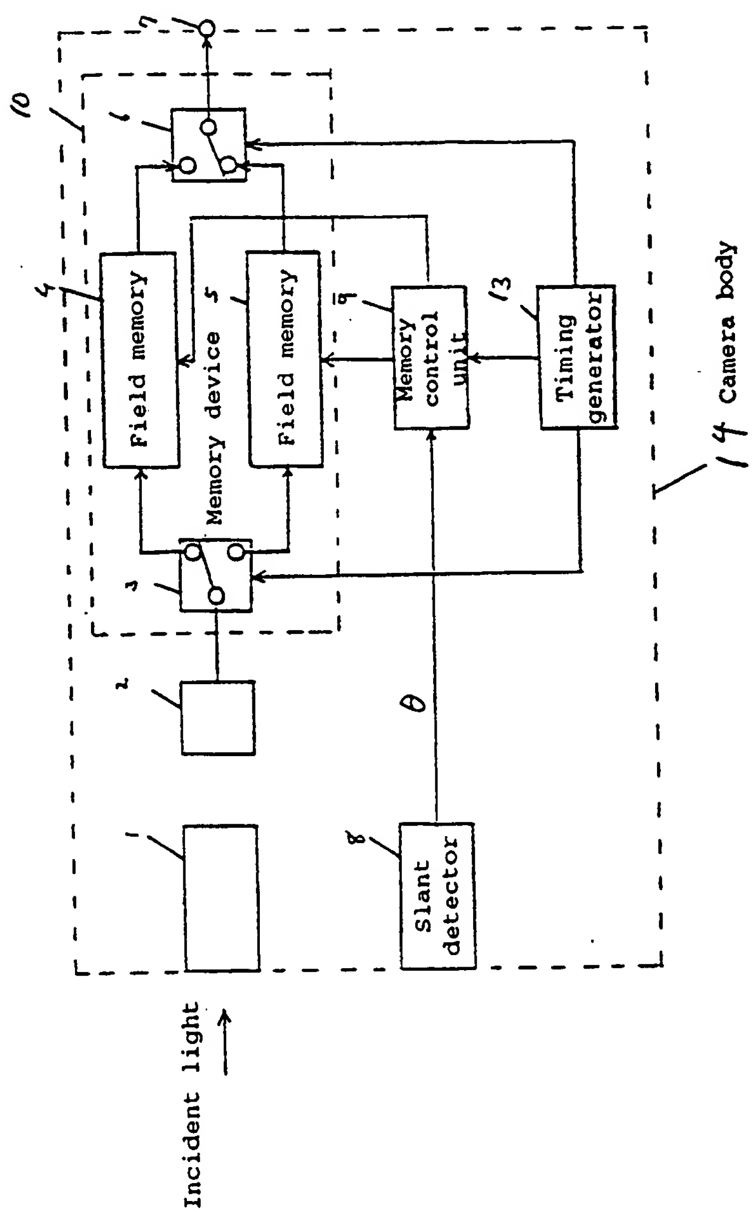

Field memory
Memory device
Field memory
Memory control unit
Timing generator
Camera body
Slant detector
Incident light
10
7
6
4
5
9
13
14
3
2
1
8
θ

Fig. 2

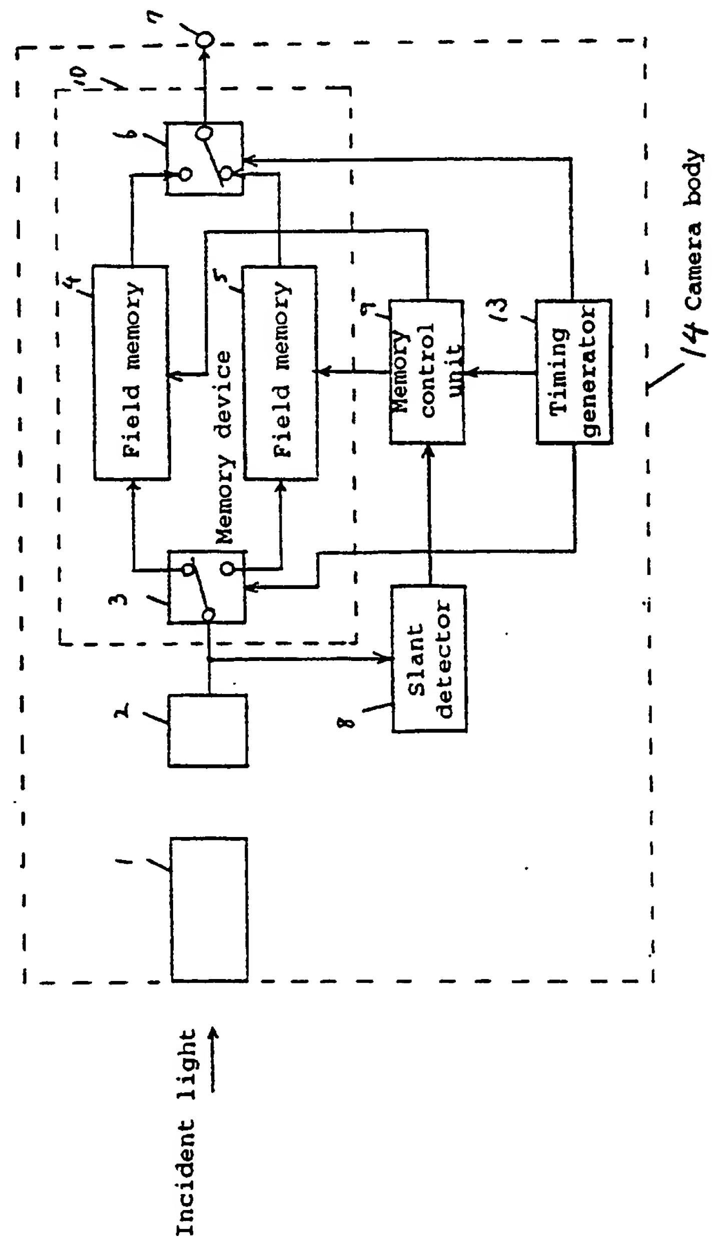
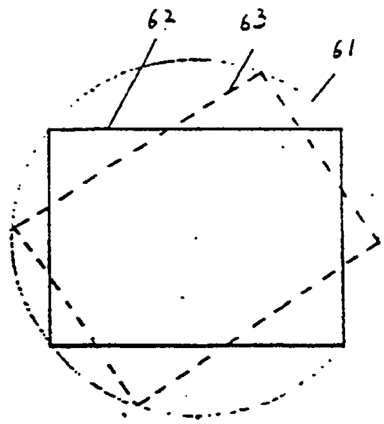

Incident light
1
2
3
4
5
6
7
8
9
10
13
Field memory
Memory device
Field memory
Memory control unit
Timing generator
Slant detector
14 Camera body

Fig. 3



61 ... Video margin circle
62 ... First video region
63 ... Second video region

Fig. 4

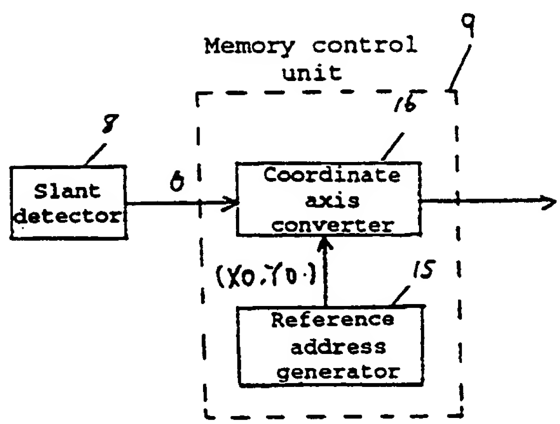


Fig. 5

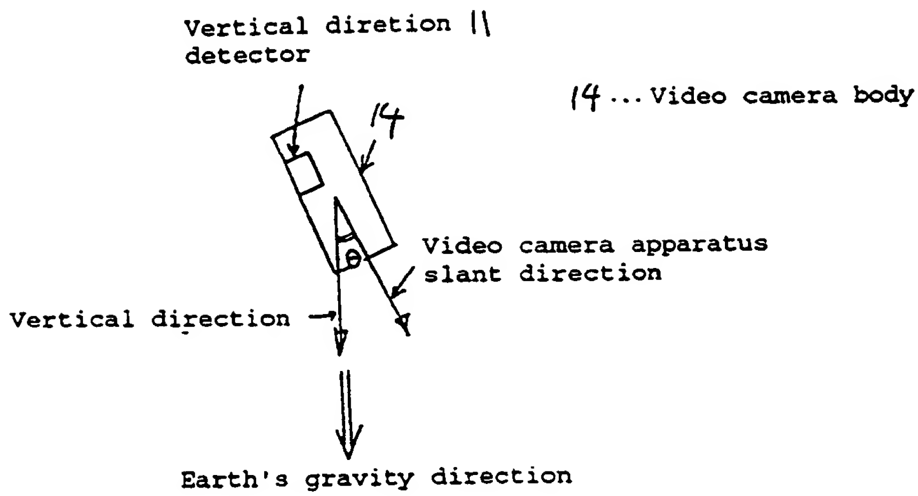

Vertical diretion 11
detector
14 ... Video camera body
14
θ
Video camera apparatus
slant direction
Vertical direction
Earth's gravity direction

Fig. 6

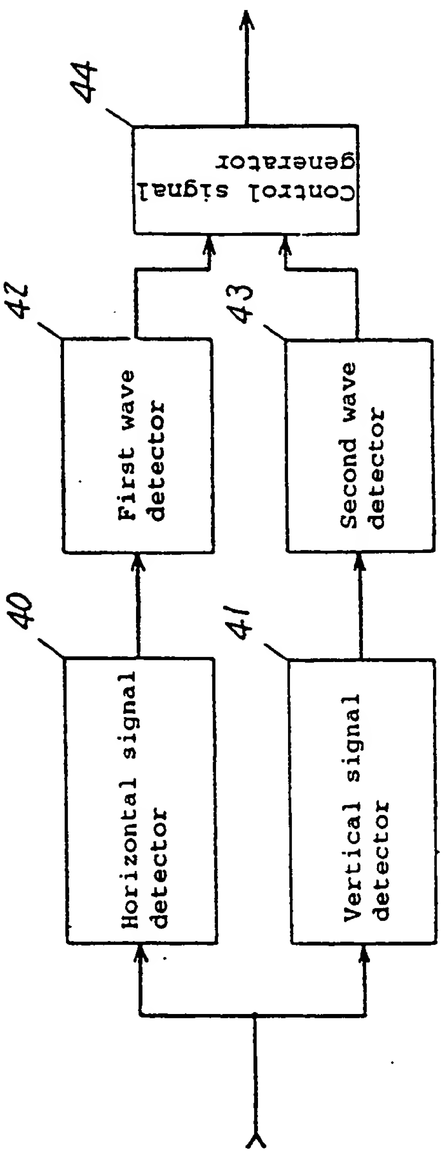

44
Control signal generator
42
First wave detector
43
Second wave detector
40
Horizontal signal detector
41
Vertical signal detector

Fig. 7

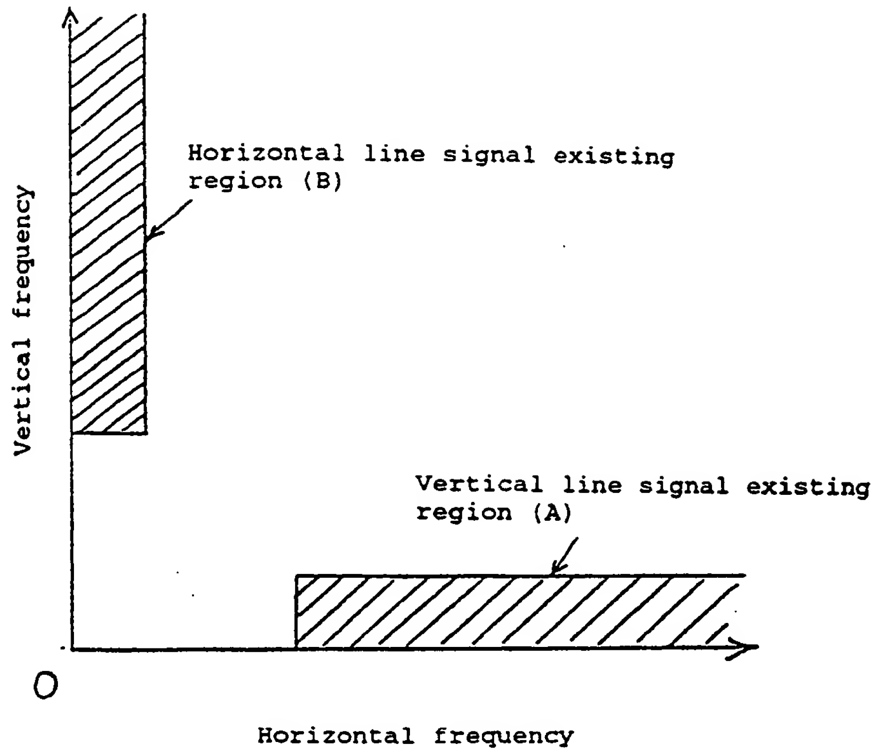

Horizontal line signal existing region (B)
Vertical frequency
Vertical line signal existing region (A)
O
Horizontal frequency

Fig. 8

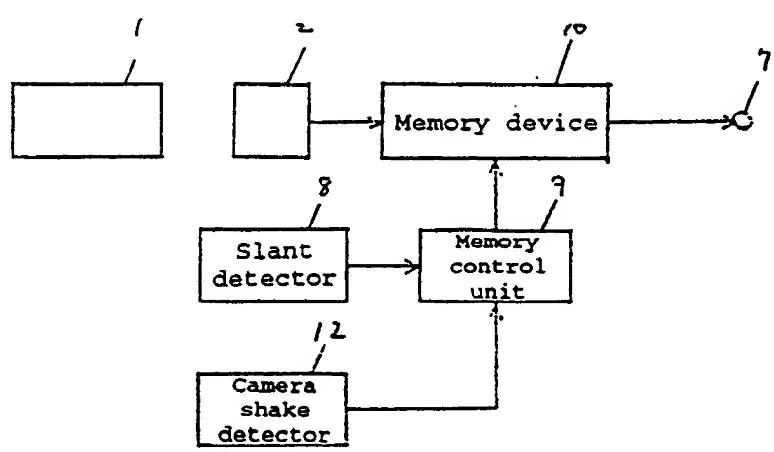

1
2
10
7
Memory device
8
9
Slant detector
Memory control unit
12
Camera shake detector

Fig. 9

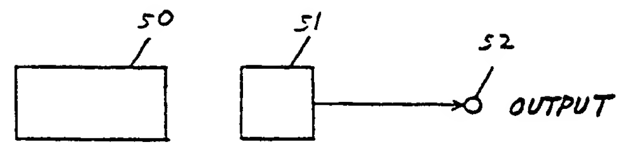


Fig. 10

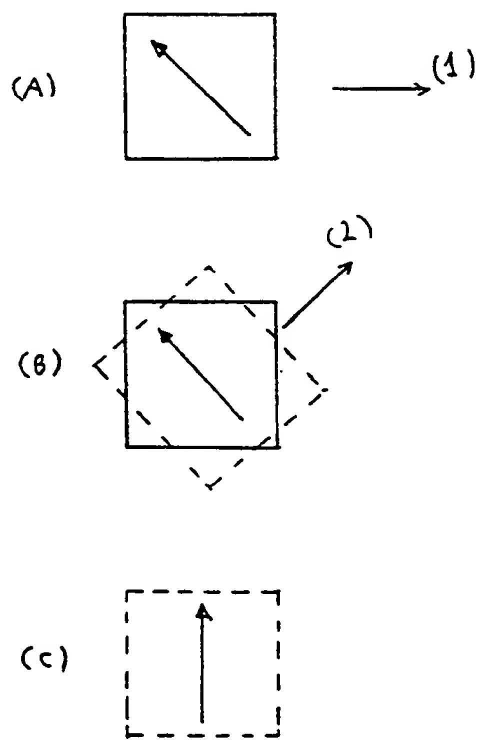


Fig. 11

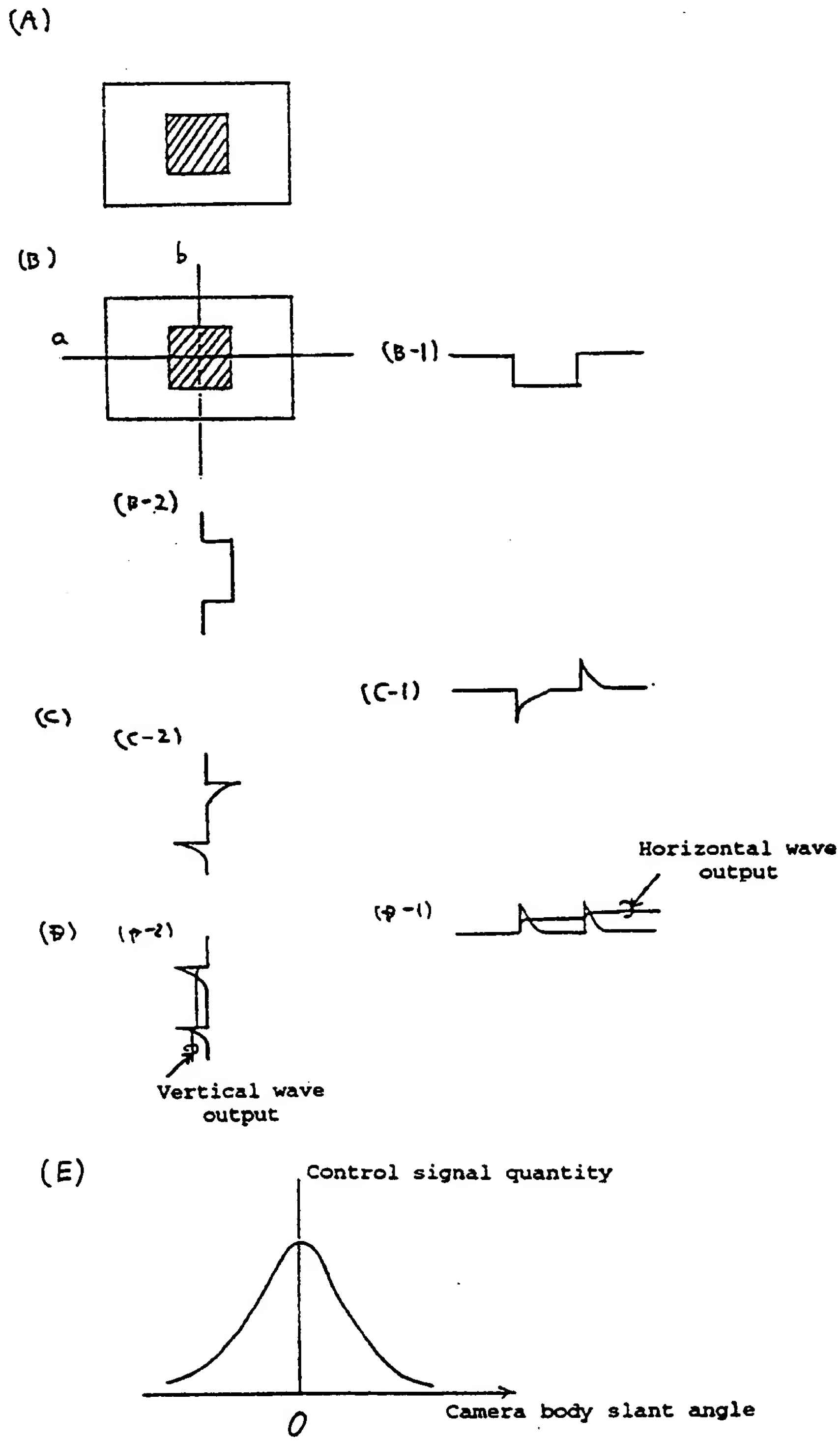
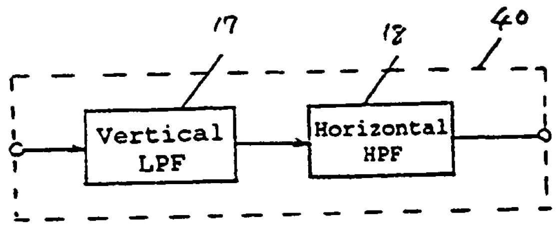
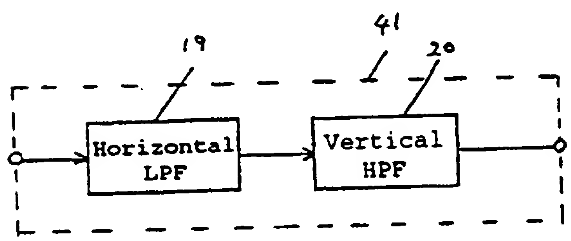

(A)
(B)
b
a
(B-1)
(B-2)
(C)
(C-1)
(C-2)
(D)
(D-1)
(D-2)
Horizontal wave output
Vertical wave output
(E)
Control signal quantity
Camera body slant angle
0

Fig. 12

(A)


17
18
40
Vertical
LPF
Horizontal
HPF

(B)


19
41
20
Horizontal
LPF
Vertical
HPF